

PCT

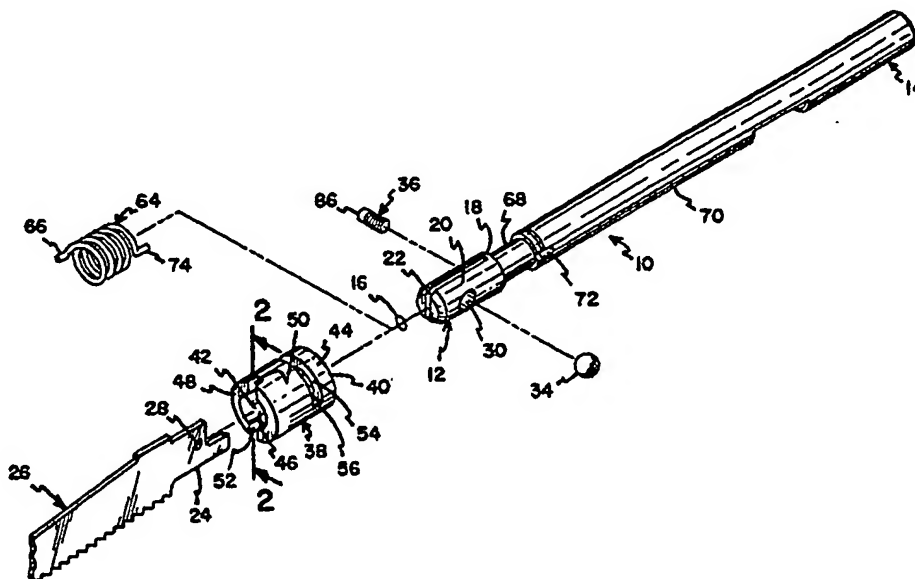
WORLD INTELLECTUAL PROPERTY ORGANIZATION  
International Bureau



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification <sup>6</sup> : <b>B23D 51/10, B23B 31/22</b>		A1	(11) International Publication Number: <b>WO 95/27583</b>
			(43) International Publication Date: 19 October 1995 (19.10.95)
(21) International Application Number: PCT/US95/03120			(81) Designated States: European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).
(22) International Filing Date: 9 March 1995 (09.03.95)			
(30) Priority Data: 08/226,780 12 April 1994 (12.04.94) US			
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(54) Title: TOOLLESS QUICKCHANGE BLADE CLAMP FOR RECIPROCATING SAWS



(57) Abstract

A clamping system for attaching a saw blade (26) to a blade carrier (10) of a reciprocating saw includes a clamp member (38) having a tubular body (40) and a hollow interior (42). The clamp member (38) is mounted on the free end (12) of a blade carrier (10) which has a longitudinal slot (22) for receiving the shank (24) of a saw blade (26). The free end (12) of the blade carrier (10) has an aperture (26) in its side wall. In a preferred embodiment a ball (34) is received within the aperture (30) and freely movable therein. The inner surface (46) of the clamp member has an eccentric groove (76) which defines a camming surface (82) engaging the ball (34). Upon rotation of the clamp member (38) to a locking position the ball (34) engages an aperture (28) in the shank (24) of the blade (26) to hold the blade in place. The clamp system is designed to accept saw blades having standard universal designs.

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TOOLLESS QUICKCHANGE BLADE CLAMP  
FOR RECIPROCATING SAWS  
BACKGROUND OF THE INVENTION

The present invention relates to reciprocating power saws and more specifically to a clamping system that permits the quick and easy removal and replacement of the blade. An inherent problem with reciprocating saws is that the blade of the saw quickly becomes dull and/or breaks requiring frequent blade changes. Prior art blade assemblies typically require a tool, such as a screwdriver or Allen wrench to change the blade. This is a slow and at times difficult process. Moreover, at times the required tool may not be available having been misplaced or lost. To address these problems a number of prior art designs use a blade clamp which does not require a tool.

For example, U.S. Patent 3,583,716 discloses one such tool-less assembly for attaching and locking the saw blade in place. The shank of the saw blade is received within a slot in a saw bar which is driven by a motor. An aperture is provided in the shank of the blade. An aperture is likewise provided in the saw bar in communication with the slot receiving the blade shank. A ball is mounted in and freely removable within the aperture in the saw bar. A collar is mounted on the saw bar and is freely rotatable about the saw bar. The collar has an eccentrically grooved surface functioning as a cam surface engaging the ball. When the blade is inserted into the saw bar the collar is rotated to shift the ball to contact the aperture in the shank of the blade. In this position the blade is locked in place until the collar is rotated to an unlocked position. In order to stabilize the blade within the saw bar a pin is provided in the saw bar extending into the longitudinal slot. The shank of the saw blade is provided with a notch or recess which receives the pin seating the saw blade within the saw bar.

U.S. Patent 3,823,473 also discloses a tool-less attachment means for a saber saw. The patent

describes several embodiments of an attachment assembly where pins or balls engage the shank of a blade to secure the blade in place.

U.S. Patent 3,927,893 also discloses an  
5 assembly adapted to engage the blade of a reciprocating tool and secure the blade in position. This apparatus includes a ball which is selectively engaged with a recess or dimple in a blade to seat the blade firmly in the assembly.

10 While these prior art patents describe a blade clamp assembly which does not require the use of a tool, each requires the use of a blade with a shank specifically designed for the patented structure. For example, in U.S. Patent 3,583,716 the shank of the blade  
15 is provided with a notch that engages a pin in the tool bar to seat and stabilize the saw in the saw bar. Manufacturers of blades for reciprocating saws have standardized the width and length of the shank of the blade and the position of the aperture or hole in the  
20 shank. It is desirable for the power saw to accept blades having the standardized dimensions and configurations. The user of the saw is thus not limited in his ability to obtain acceptable replacement blades.

Thus, the design of the present invention was  
25 developed to provide a tool-less clamp assembly for a reciprocating saw which does not require a unique shank design but, on the other hand, will accept the standardized and universal shank design of many blade manufacturers.

30 In addition the attachment means for the saw blade must stabilize the blade and prevent movement of the blade when it is locked in the operative position. The prior art discloses a number of different such stabilization means. As mentioned, U.S. Patent  
35 3,583,716, for example, discloses a pin that is received in a recess in the shank of the blade. U.S. Patent 5,103,565 discloses in one embodiment a blade holder for

receiving a universal type blade where a pin is designed to engage a radiused surface on the shank. Despite the fact that such universal blades are standard in many respects, one cannot always rely upon the radiused surface engaged by the pin of the '565 patent to be in a standard location. It can be seen that these prior art patents disclose additional mechanical elements such as pins in order to stabilize the saw blade.

Accordingly, the present invention is also directed toward a clamp assembly which will affect blade stabilization without complex and unnecessary hardware designs.

#### SUMMARY OF THE INVENTION

The present invention is the combination in a reciprocating power saw of a blade carrier that is driven by a motor and which has a free end with a slot along its central longitudinal axis for receiving the shank portion of a saw blade wherein the shank portion has an aperture. The free end of the blade carrier further has an aperture in its sidewall that provides communication between the outer surface of the free end and the blade receiving slot. A clamp member comprising a tubular body and a hollow interior is mounted on the free end of the blade carrier. The inner surface of the clamp member has an eccentric groove. In the preferred embodiment the clamp member has a length measured along its longitudinal central axis that is at least equivalent to the length of the shank portion of the blade. The inner diameter of the clamp member is substantially equivalent to the width of the shank portion of the blade. The clamp member is attached to the blade carrier for rotation between first and second positions. It has a means captured in the aperture of the free end of the blade carrier and in engagement with the eccentric groove in the clamp member for cooperating with the aperture in the shank portion to secure the saw blade to the blade carrier when the clamp member is in a

first position. When the clamp member is rotated to a second position the saw blade is released for removal.

In a preferred embodiment a ball is mounted within the aperture in the sidewall of the blade carrier and is freely movable within the aperture. The eccentric groove in the inner surface of the clamp member functions as a camming surface forcing the ball to engage the aperture in the shank portion of the blade in the first position of the clamp member. A torsion spring is attached to the blade carrier and the clamp member to bias the clamp member toward its first or locking position.

The present invention thus incorporates a tool-less clamp assembly that will accept a saw blade of universal and standardized design. The clamp assembly is dimensioned and constructed so that in the locked position the blade is stabilized eliminating the need for incorporating stabilizing hardware into the clamp. These and other advantages of the present invention will become apparent with reference to the accompanying drawings, detailed description of the preferred embodiment and claims.

#### BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is an exploded view in perspective illustrating a preferred embodiment of the present invention;

FIGURE 2 is a view in cross section taken along lines 2-2 of Fig. 1;

FIGURES 3A-3D are elevational and sectional drawings of the collar of the embodiment of the invention of Figs. 1-2;

FIGURE 4 is a view in cross section similar to Fig. 2 but showing an alternative embodiment of the present invention;

FIGURES 5A-D are elevational and sectional drawings of the collar of the embodiment of the invention of Fig. 4;

FIGURE 6 is a plan view of an alternative structure of the collar of the embodiment of Figs. 1-2.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings, wherein like numerals represent like parts throughout the several views, there is illustrated a blade carrier 10 having a free end 12 and an end 14 which is operatively connected to a motor (not shown) of a power saw to impart reciprocating motion to blade carrier 10 along its central longitudinal axis as shown at 16. Free end 12 has a cylindrical head 18 and an outer surface 20. Head 18 has a slot 22 disposed therein along longitudinal axis 16. Slot 22 is adapted to receive a shank member 24 of a saw blade 26. Shank member 24 is a standardized or universal design adapted for use with any conventional reciprocating power saw. Thus, as shown more specifically in Fig. 2 shank member 24 has a standardized width as indicated at X and a standardized length as indicated at Y. Disposed at a standardized location on shank member 24 is an aperture 28.

Cylindrical head 18 has an aperture 30 providing communication between outer surface 20 and slot 22. Head 18 is provided with a second aperture 32 also providing communication between outer surface 20 and slot 22. A ball 34 is received within aperture 30 and has a diameter selected such that ball 34 will move freely within aperture 30 as will be described in more detail hereafter. A pin having a diameter selected such that it will freely move within aperture 30 and having rounded ends may also be used in lieu of ball 34. Aperture 32 is adapted to receive a stop pin 36. In one embodiment pin 36 may be a roll or spring pin and aperture 32 may be a smooth bore in which the spring pin is received. In an alternative embodiment second aperture 32 may be threaded and pin 36 may be provided with external threads that mate with the threads of aperture 32.

A clamp collar 38 is mounted on cylindrical head 18. Clamp collar 38 has a tubular body member 40 with a hollow interior 42, an outer surface 44 and an inner surface 46. Body member 40 has an inner diameter  
5 selected to be only slightly greater than the width X of shank member 24. Body member 40 has an outer end 48 and a pair of notches 50 and 52 spaced 180 degrees from each other about the circumference of outer end 48. In one embodiment of the present invention body member 40 has a  
10 slot 54 providing an opening between outer surface 44 and inner surface 46. Slot 54 extends partially about the circumference of body member 40. Slot 54 defines a pair of stop surfaces 56 and 58 the purpose of which will be described in more detail hereafter. Turning  
15 specifically to Figs. 2 and 3, body member 40 has an inner end 60 having a recess at 62. A torsion spring 64 has a first end 66 which is received within recess 62. Torsion spring 64 is coiled about a section 68 of blade carrier 10. A section 70 of blade carrier 10 is  
20 provided with a recess 72 in which is received an end 74 of torsion spring 64.

Torsion spring 64 biases clamp collar 38 toward a first position corresponding to blade 26 being locked in carrier 10. Fig. 3 illustrates the structure  
25 of clamp collar 38 in more detail. Inner surface 46 of tubular member 40 is provided with an eccentric circumferential groove 76 shown specifically in Figs. 3c and 3d. Groove 76 varies in depth from a minimum at 78 to a maximum at 80. Groove 76 defines a camming surface  
30 82.

The operation of the present invention will now be described with reference to the embodiment of Figs. 1-3. As stated previously ball 34 is received within aperture 30 and freely movable within aperture  
35 30. Ball 34 is captured in eccentric groove 76 as clamp collar 38 rotates about cylindrical head 18. Ball 34 under the influence of camming surface 82 is urged



inward toward central axis 16 to the first or locked position of collar 38 and allowed to move outward or away from axis 16 toward a second or unlocked position of collar 38. In the first or locked position ball 34  
5 seats at least partially in aperture 28 of shank member 24 to secure blade 26. When collar 38 is rotated to its second position ball 34 is disengaged from aperture 28 allowing blade 26 to be removed. By positively biasing clamp collar 38 toward the first or locked position  
10 there is no loosening of blade 26 due to vibration during operation of the saw. On the other hand the positive biasing force of torsion spring 64 toward the locked position tightens clamp collar 38 with vibration. Aperture 30 and ball 34 are positioned with respect to  
15 outer end 48 of clamp collar 38 so that blade 26 is restrained from pivoting about ball 34. This is accomplished by locating aperture 30 and ball 34 on cylindrical head 18 in a position such that blade 26 will engage a radiused surface 84 upon minimal pivoting  
20 of blade 26.

Further by sizing clamp collar 38 such that its inside diameter is substantially equal to the width X of shank portion 24 and such that its length is at least as great as the length Y of shank portion 24,  
25 blade 26 is stabilized by the single ball 34 and collar 38 assembly. Pin 36 serves two functions. First, pin 36 is inserted into aperture 32 such that a portion of pin 36 projects outward from surface 20 of cylindrical head 18. Pin portion 86 rides within slot 54. When  
30 blade 26 is removed pin 36 retains collar 38 on cylindrical head 18 through the engagement of pin 36 with sidewalls 88 and 90 of slot 54. Upon rotation of collar 38, portion 86 of pin 36 will engage stop surfaces 56 and 58 to limit rotation of clamp collar 38  
35 so that torsion spring 64 cannot be damaged by over-rotation in one direction and in the other direction to

maintain a preloaded tension on clamp collar 38 when blade 26 is removed.

Notches 50 and 52 formed in outer end 48 provide a means to remove broken blade shanks. Notches 50 and 52 have a depth measured along central axis 16 that extends beyond where breaks usually occur in shank 24. A broken shank thus can be removed by aligning notches 50 and 52 with slot 22 and a replacement blade may be used to pry the broken shank from cylindrical head 18.

Figs. 4-5 illustrate an alternative embodiment of the present invention. Instead of slot 54 a second eccentric groove 92 is formed on inner surface 46'. Groove 92 extends about a portion of the circumference of clamp collar 38' as illustrated in Fig. 5D. Eccentric groove 92, like groove 76', also varies in depth from a minimum at 94 to a maximum at 96. Second eccentric groove 92 as shown in Figs. 5C and 5D is essentially 90 degrees out of phase with respect to eccentric groove 76'. In other words maximum depth 96 of groove 92 is positioned about central axis 16' 90 degrees from the location of maximum depth 80' of eccentric groove 76'. An aperture 98 is located in tubular body member 38' permitting communication between outer surface 44' and hollow interior 42'. Aperture 98 is located to provide access to cylindrical member 18' at the position of eccentric groove 92. In this embodiment set screw or roll pin 36' has a stop portion 86' projecting above the outer surface of cylindrical head 18'. Stop portion 86' is captured in eccentric groove 92. In this manner roll pin 36' functions to retain clamp collar 38' on cylindrical head 18' when blade 26' is removed. Pin 36' also cooperates with groove 92 to limit the rotation of clamp collar 38' as described above with references to Figs. 1-3.

Fig. 6 illustrates an alternative embodiment of clamp collar 38 of Figs. 1-3. This embodiment clamp

collar 38'' is the same in all respects to clamp collar 38 except for a modification of slot 54. In this embodiment slot 54'' is modified to allow for disassembly of the clamp mechanism by removal of clamp collar 38'' from cylindrical head 18. This would allow cleaning of the mechanism. Accordingly, an elbow slot extension 100 is provided in tubular body 40'' communicating with slot 54''. Slot extension 100 has an opening 102 at inner end 60''. For removal collar 38'' is rotated and forced against torsion spring 64 so that pin 36 enters groove 100. Pin 36 thus no longer is in engagement with slot 54'' allowing clamp collar 38'' to be removed with pin 36 travelling through opening 102. This structure is a conventional push and twist type connection known in other prior art applications.

It should be appreciated that the above disclosure is illustrative and changes may be made in detail, especially in matters of shape, size and arrangement of parts within the spirit and scope of the present invention.

From the above description it should be apparent that the present invention provides a quick and easy clamp assembly with minimum mechanical parts. By virtue of its unique design the clamp assembly functions with blades of universal and standardized configuration.

WHAT IS CLAIMED IS:

1. In a reciprocating power saw having a motor for driving a saw blade having a shank portion with an aperture formed therein, the combination comprising:

a blade carrier driven by said motor and having a free end, said free end having a slot formed therein along a central longitudinal axis thereof in which said shank portion of said saw blade is received, said free end further having an aperture in its sidewall providing communication between an outer surface of said free end and said slot;

a clamp member having a tubular body and a hollow interior in which said free end of said blade carrier is received, said clamp member having a first eccentric groove formed in its inner surface, said clamp member further having an inside diameter corresponding generally to the width of said shank portion of said blade member;

means for attaching said clamp member to said free end of said blade carrier for rotation about said free end between at least first and second positions;

means captured in said aperture in said free end of said blade carrier and in engagement with said first eccentric groove for cooperating with said aperture in said shank portion to secure said blade to said blade carrier when said clamp member is in said first position and release said blade when said clamp member is in said second position.

2. The combination according to claim 1 wherein said tubular body has a slot extending partially about its circumference and further comprising a stop means attached to said free end of said blade carrier for cooperating with said slot in said tubular body to limit rotation of said clamp member between said first and second positions.

3. The combination according to claim 1 wherein said tubular body has a second eccentric groove formed in its inner surface and further comprising means attached to said free end

of said blade carrier and received within said second eccentric groove to retain said clamp member on said free end and limit rotation of said clamp member between said first and second positions.

4. The combination according to claim 3 wherein said second eccentric groove extends partially about the inner surface of said tubular member defining stop means for limiting rotation of said clamp member between said first and second positions.

5. The combination in accordance with claim 2 or claim 3 further comprising a torsion spring means attached to said blade carrier and said clamp member for biasing said clamp member toward said first position.

6. The combination according to claim 1 wherein said tubular body has a pair of notches in the end thereof into which said blade is inserted, said notches oppositely disposed about the circumference of said tubular body so that said notches are aligned with said slot in said free end of said blade carrier when said clamp member is in said second position.

7. In a reciprocating power saw having a motor for driving a saw blade having a shank portion with an aperture formed therein the combination comprising:

a blade carrier operatively connected to said motor, said blade carrier having a free end with an elongated slot formed therein along a central longitudinal axis of said blade carrier, said slot adapted to receive said shank portion of said blade, said blade carrier further having first and second apertures in its sidewall providing communication between an outer surface of said free end and said slot;

a clamp member having a tubular body and a hollow interior in which said free end of said blade carrier is received, said tubular body having a slot extending partially

about its circumference providing communication between an outer surface of said tubular body and said hollow interior, said tubular body having an inner surface with an eccentric groove formed therein and extending circumferentially about said inner surface;

a ball received within said first aperture in said free end and freely movable within said aperture, said ball captured within said eccentric groove, a stop pin mounted within said second aperture in said free end and having a stop portion captured within said slot in said clamp member to retain said clamp member on said free end;

a torsion spring attached to said blade carrier and to said clamp collar biasing said clamp collar toward a first position wherein said ball is urged into engagement with said aperture in said shank of said blade to secure said blade carrier, said clamp member rotatable from said first position to a second position wherein said ball disengages from said aperture in said shank allowing said blade to be removed from said blade carrier.

8. The combination in accordance with claim 7 wherein said clamp collar has a pair of notches in the end thereof in which said blade is inserted, said notches diametrically disposed with respect to each other whereby upon rotation of said clamp member to said second position said notches are in general alignment with said slot in said blade carrier.

## AMENDED CLAIMS

[received by the International Bureau on 23 August 1995 (23.08.95);  
original claims 1-8 replaced by amended claims 1-8 (3 pages)]

1. In a reciprocating power saw having a motor for driving a saw blade having a shank portion with an aperture formed therein, the combination comprising:

a blade carrier driven by said motor and having a free end, said free end having a slot formed therein along a central longitudinal axis thereof in which said shank portion of said saw blade is received, said free end further having an aperture in its sidewall providing communication between an outer surface of said free end and said slot;

a clamp member having a tubular body and a hollow interior in which said free end of said blade carrier is received, said clamp member having a first eccentric groove formed in its inner surface;

means for attaching said clamp member to said free end of said blade carrier for rotation about said free end between at least first and second positions;

means captured in said aperture in said free end of said blade carrier and in engagement with said first eccentric groove for cooperating with said aperture in said shank portion to secure said blade to said blade carrier when said clamp member is in said first position and release said blade when said clamp member is in said second position; and

wherein said clamp member has a length measured along said central longitudinal axis at least equal to the length of said shank portion of said blade and said clamp member having an inside diameter substantially equivalent to the width of said shank portion, whereby said blade is stabilized during its reciprocal motion.

2. The combination according to claim 1 wherein said tubular body has a slot extending partially about its circumference and further comprising a stop means attached to said free end of said blade carrier for cooperating with said slot in said tubular body to limit rotation of said clamp member between said first and second positions.

3. The combination according to claim 1 wherein said tubular body has a second eccentric groove formed in its inner surface and further comprising means attached to said free end of said blade carrier and received within said second eccentric groove to retain said clamp member on said free end and limit rotation of said clamp member between said first and second positions.

4. The combination according to claim 3 wherein said second eccentric groove extends partially about the inner surface of said tubular member defining stop means for limiting rotation of said clamp member between said first and second positions.

5. The combination in accordance with claim 2 or claim 3 further comprising a torsion spring means attached to said blade carrier and said clamp member for biasing said clamp member toward said first position.

6. The combination according to claim 1 wherein said tubular body has a pair of notches in the end thereof into which said blade is inserted, said notches oppositely disposed about the circumference of said tubular body so that said notches are aligned with said slot in said free end of said blade carrier when said clamp member is in said second position.

7. In a reciprocating power saw having a motor for driving a saw blade having a shank portion with an aperture formed therein the combination comprising:

a blade carrier operatively connected to said motor, said blade carrier having a free end with an elongated slot formed therein along a central longitudinal axis of said blade carrier, said slot adapted to receive said shank portion of said blade, said blade carrier further having first and second apertures in its sidewall providing communication between an outer surface of said free end and said slot;



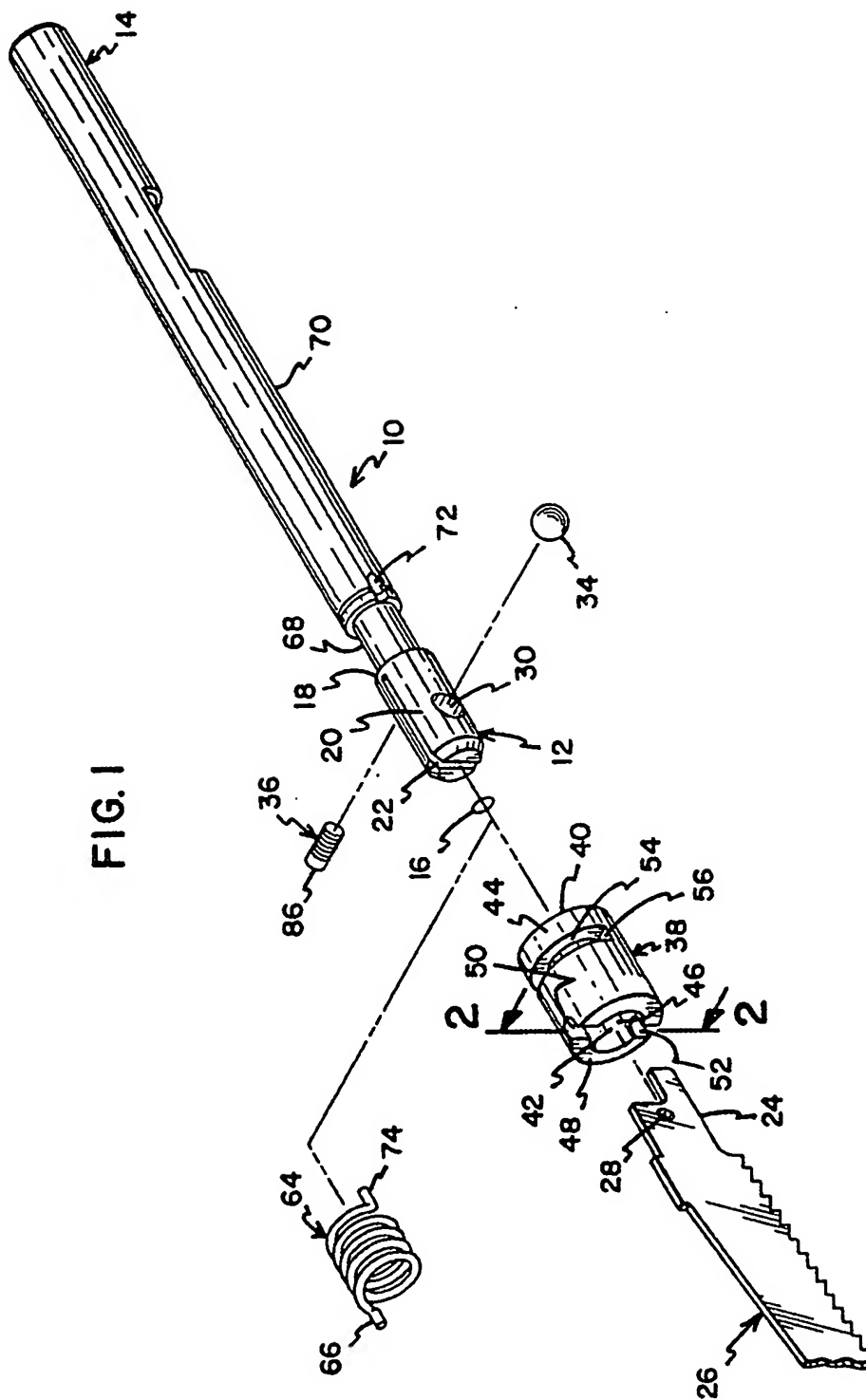
a clamp member having a tubular body and a hollow interior in which said free end of said blade carrier is received, said tubular body having a slot extending partially about its circumference providing communication between an outer surface of said tubular body and said hollow interior, said tubular body having an inner surface with an eccentric groove formed therein and extending circumferentially about said inner surface;

a ball received within said first aperture in said free end and freely movable within said aperture, said ball captured within said eccentric groove, a stop pin mounted within said second aperture in said free end and having a stop portion captured within said slot in said clamp member to retain said clamp member on said free end;

a torsion spring attached to said blade carrier and to said clamp collar biasing said clamp collar toward a first position wherein said ball is urged into engagement with said aperture in said shank of said blade to secure said blade carrier, said clamp member rotatable from said first position to a second position wherein said ball disengages from said aperture in said shank allowing said blade to be removed from said blade carrier.

8. The combination in accordance with claim 7 wherein said clamp collar has a pair of notches in the end thereof in which said blade is inserted, said notches diametrically disposed with respect to each other whereby upon rotation of said clamp member to said second position said notches are in general alignment with said slot in said blade carrier.

FIG. 1



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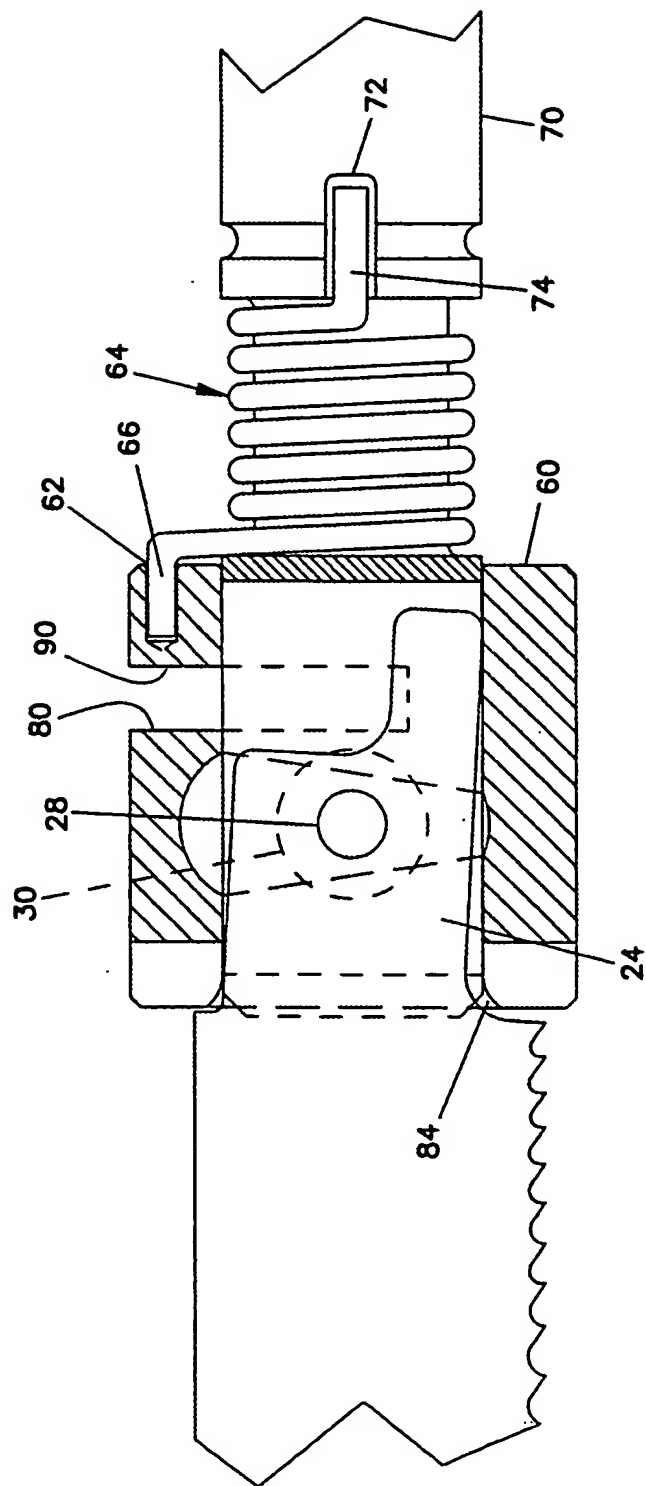


FIG. 2

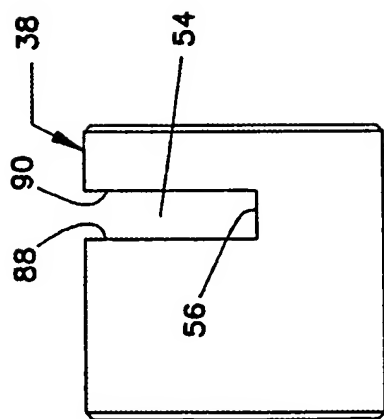


FIG. 3A

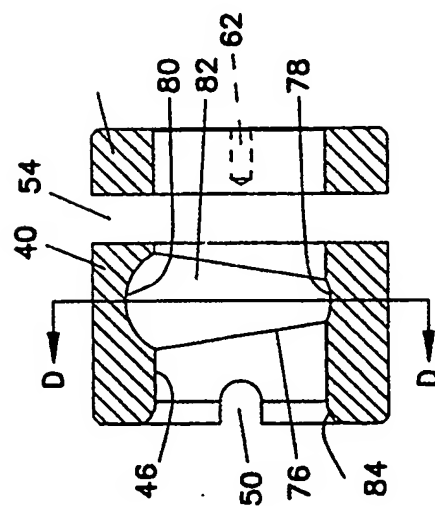


FIG. 3C

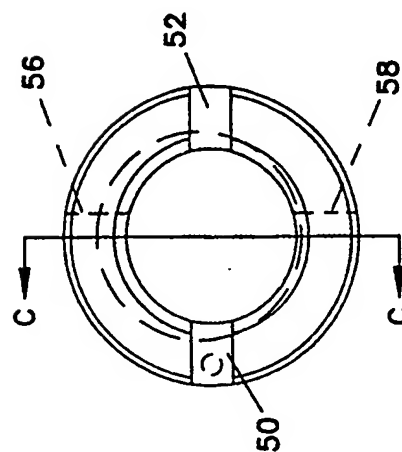


FIG. 3B

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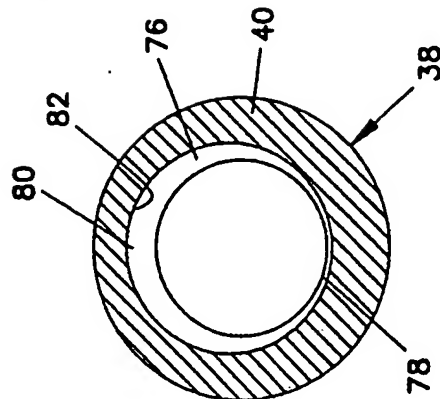


FIG. 3D

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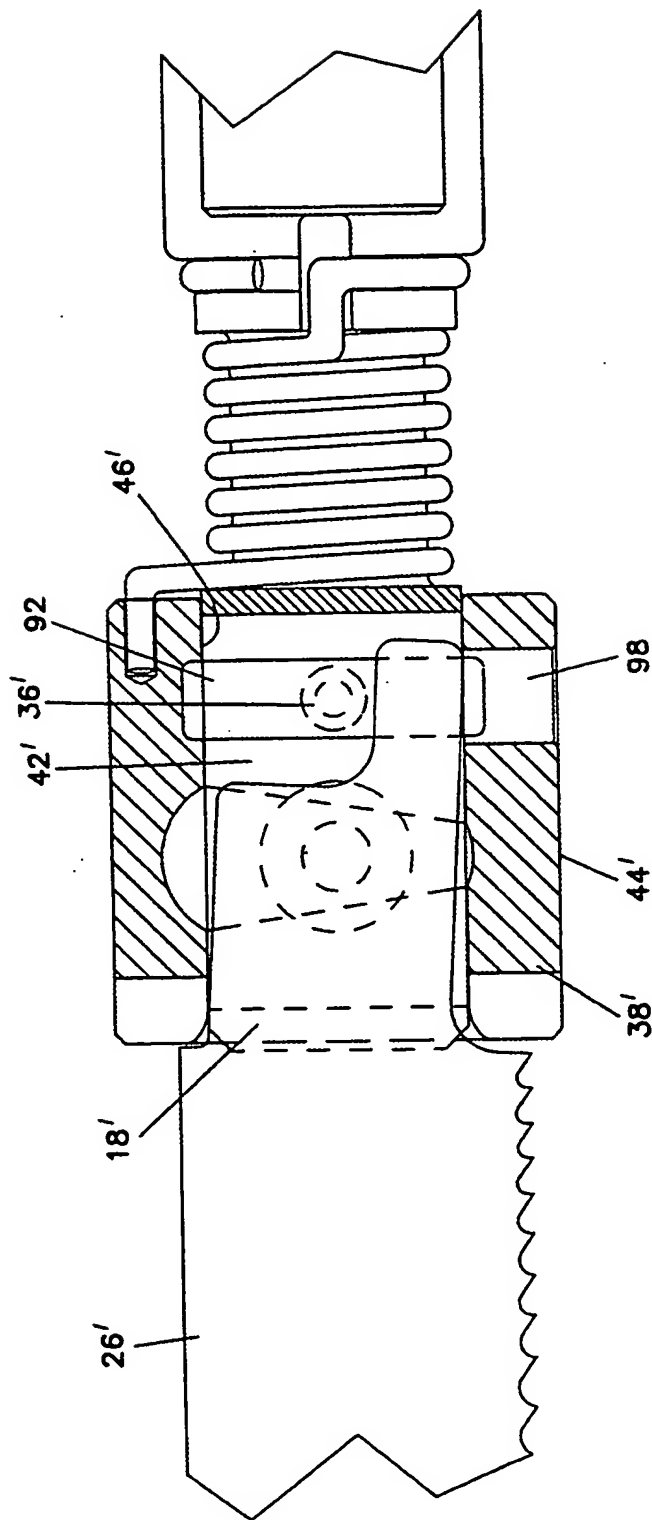


FIG. 4

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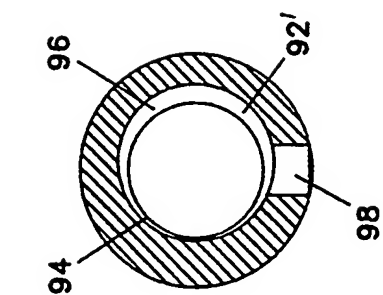


FIG. 5D

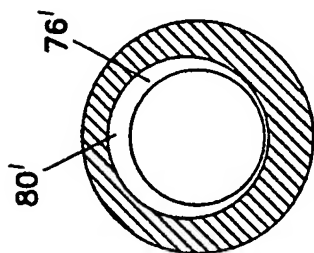


FIG. 5C

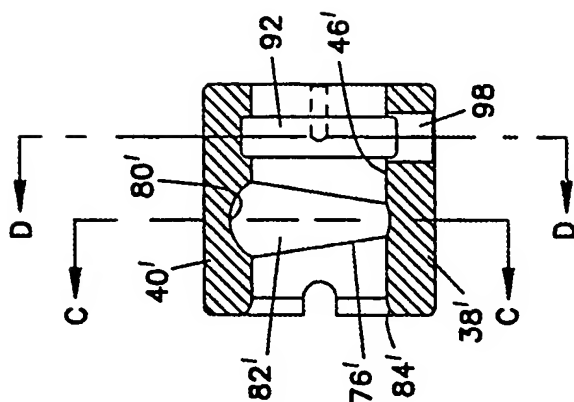


FIG. 5B

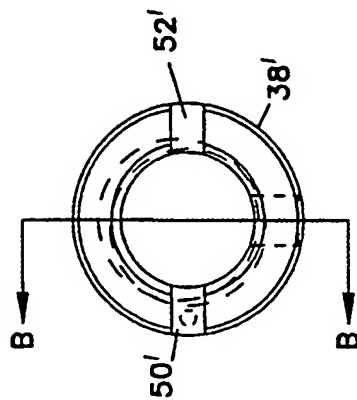


FIG. 5A

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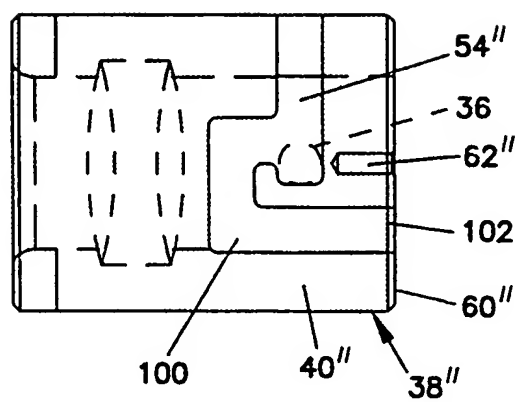


FIG. 6

# INTERNATIONAL SEARCH REPORT

Inter      nal Application No  
PCT/US 95/03120

A. CLASSIFICATION OF SUBJECT MATTER  
IPC 6    B23D51/10    B23B31/22

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6    B23D    B23B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US,A,3 823 473 (S.J. HOFFMAN) 16 July 1974 cited in the application see column 7, line 47 - column 8, line 30 see column 9, line 47 - column 10, line 47 see figures 8A-8C,11A-11C ---	1,3-5,7
X	US,A,3 583 716 (M.F. DANIEL JR) 8 June 1971 cited in the application see column 2, line 5 - line 71 see figures 2-6 ---	1
A	DE,U,93 05 188 (KRESS-ELEKTRIK GMBH & CO ELEKTROMOTORENFABRIK) 17 June 1993 see page 9, line 20 see page 11, line 19 - line 25 see figures -----	2,4,6,8

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

### \* Special categories of cited documents:

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Date of the actual completion of the international search

20 June 1995

Date of mailing of the international search report

07.07.95

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# INTERNATIONAL SEARCH REPORT

Information on patent family members

Intern Application No

PCT/US 95/03120

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A-3823473	16-07-74	US-A- 3750283	07-08-73
US-A-3583716	08-06-71	NONE	
DE-U-9305188	17-06-93	NONE	